

Reply to Office Action of 07/26/2005  
Amendment Dated: November 28, 2005

Appl. No.: 09/975,944  
Attorney Docket No.: CSCO-012 /4912

Listing of Claims

1 1 (Currently Amended): A method of processing a plurality of layer-3 datagrams in  
2 a first edge router, said first edge router being connected to a second edge router by a layer-2  
3 network, said method comprising:

4 provisioning in said first edge router a plurality of virtual circuits to said second edge  
5 router on said layer-2 network, said plurality of virtual circuits being associated with a layer-  
6 3 route;

7 receiving in said first edge router said plurality of layer-3 datagrams;

8 determining in said first edge router a subset of layer-3 datagrams, with each  
9 datagram in said subset of layer-3 datagrams having a corresponding layer-3 route equal to  
10 said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said plurality  
11 of layer-3 datagrams;

12 encapsulating each of said subset of layer-3 datagrams in a corresponding plurality  
13 of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of said subset  
14 of layer-3 datagrams being encapsulated for sending on a first one of said plurality of virtual  
15 circuits and all of the plurality of layer-2 packets corresponding to some other of said subset  
16 of layer-3 datagrams being encapsulated for transmission on another one of said plurality of  
17 virtual circuits; and

18 sending said plurality of layer-2 packets related to said subset of layer-3 datagrams  
19 on said layer-2 network according to said encapsulating.

1 2 (Currently Amended): The method of claim 1, wherein said determining comprises  
2 using a destination address comprised in each of said layer-3 datagrams to determine said  
3 corresponding layer-3 route,

4 wherein said determining further determines whether to transmit each of said subset  
5 of layer-3 datagrams in either said first one of said plurality of virtual circuits or said another  
6 one of said plurality of virtual circuits, and

7 wherein said encapsulating comprises using a header which identifies the determined  
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

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1           3 (Original): The method of claim 2, wherein said layer-2 network comprises a  
2 plurality of switches providing a plurality of physical paths between said first edge router  
3 and said second edge router, said first one of said plurality of virtual circuits being provided  
4 on a first one of said plurality of physical paths and said second one of said plurality of  
5 virtual circuits being provided on a second one of said plurality of physical paths.

1           4 (Original): The method of claim 2, further comprising selecting one of said  
2 plurality of virtual circuits for transmitting each of said subset of layer-3 datagrams, wherein  
3 said encapsulating is performed after said selecting.

1           5 (Original): The method of claim 4, wherein said determining comprises retrieving  
2 a route entry from a forwarding table using said destination address of a first IP datagram,  
3 wherein said route entry indicates whether said IP route is to be used to transport said first  
4 IP datagram, and wherein said selecting is performed based on said route entry.

1           6 (Original): The method of claim 5, wherein said determining is implemented in the  
2 form of a process under the control of a scheduler, wherein said process and said scheduler  
3 are implemented substantially in the form of software in said first edge router.

1           7 (Original): The method of claim 4, wherein said determining and selecting are  
2 implemented using a data structure, which when traversed using said destination address  
3 returns a layer-2 header corresponding to a virtual circuit on which a corresponding IP  
4 datagram is to be sent.

1           8 (Currently Amended): The method of claim 7, wherein said determining and said  
2 selecting are implemented in an interrupt handler and wherein said data structure comprises  
3 a tree.:

1           9 (Original): The method of claim 2, wherein layer-3 comprises Internet Protocol (IP)  
2 such that layer-3 datagrams, layer-3 protocol, and layer-3 route respectively comprise IP

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3 datagrams, IP protocol, and IP route, and wherein said layer-2 comprises asynchronous  
4 transfer mode (ATM) such that said layer-2 packets comprise ATM cells.

1 10 (Currently Amended): A computer readable medium carrying one or more  
2 sequences of instructions for causing a first edge router to process a plurality of layer-3  
3 datagrams in a first edge router, said first edge router being connected to a second edge  
4 router by a layer-2 network, wherein execution of said one or more sequences of instructions  
5 by one or more processors contained in said first edge router causes said one or more  
6 processors to perform the action of:

7 provisioning in said first edge router a plurality of virtual circuits to said second edge  
8 router on said layer-2 network, said plurality of virtual circuits being associated with a  
9 layer-3 route;

10 receiving in said first edge router said plurality of layer-3 datagrams;

11 determining in said first edge router a subset of layer-3 datagrams, with each  
12 datagram in said subset of layer-3 datagrams having a corresponding layer-3 route equal to  
13 said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said plurality  
14 of layer-3 datagrams;

15 encapsulating each of said subset of layer-3 datagrams in a corresponding plurality  
16 of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of said  
17 subset of layer-3 datagrams being encapsulated for sending on a first one of said plurality  
18 of virtual circuits and all of the plurality of layer-2 packets corresponding to some other of  
19 said subset of layer-3 datagrams being encapsulated for transmission on another one of said  
20 plurality of virtual circuits; and

21 sending said plurality of layer-2 packets related to said subset of layer-3 datagrams  
22 on said layer-2 network according to said encapsulating.

1 11 (Currently Amended): The computer readable medium of claim 10, wherein said  
2 determining comprises using a destination address comprised in each of said layer-3  
3 datagrams to determine said corresponding layer-3 route.

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4 wherein said determining further determines whether to transmit each of said subset  
5 of layer-3 datagrams in either said first one of said plurality of virtual circuits or said another  
6 one of said plurality of virtual circuits, and  
7 wherein said encapsulating comprises using a header which identifies the determined  
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

1 12 (Original): The computer readable medium of claim 11, wherein said layer-2  
2 network comprises a plurality of switches providing a plurality of physical paths between  
3 said first edge router and said second edge router, said first one of said plurality of virtual  
4 circuits being provided on a first one of said plurality of physical paths and said second one  
5 of said plurality of virtual circuits being provided on a second one of said plurality of  
6 physical paths.

1 13 (Original): The computer readable medium of claim 11, further comprising  
2 selecting one of said plurality of virtual circuits for transmitting each of said subset of layer-  
3 3 datagrams, wherein said encapsulating is performed after said selecting.

1 14 (Original): The computer readable medium of claim 13, wherein said determining  
2 comprises retrieving a route entry from a forwarding table using said destination address of  
3 a first IP datagram, wherein said route entry indicates whether said IP route is to be used to  
4 transport said first IP datagram, and wherein said selecting is performed based on said route  
5 entry.

1 15 (Original): The computer readable medium of claim 14, wherein said determining  
2 is implemented in the form of a process under the control of a scheduler, wherein said  
3 process and said scheduler are implemented substantially in the form of software in said first  
4 edge router.

1 16 (Original): The computer readable medium of claim 13, wherein said determining  
2 and selecting are implemented using a data structure, which when traversed using said

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3 destination address returns a layer-2 header corresponding to a virtual circuit on which a  
4 corresponding IP datagram is to be sent.

1 17 (Original): The computer readable medium of claim 16, wherein said determining  
2 and said selecting are implemented in an interrupt handler and wherein said data structure  
3 comprises a tree.

1 18 (Currently Amended): A first edge router for processing a plurality of layer-3  
2 datagrams, said first edge router being connected to a second edge router by a layer-2  
3 network, said first edge router comprising:

4 means for provisioning a plurality of virtual circuits to said second edge router on  
5 said layer-2 network, said plurality of virtual circuits being associated with a layer-3 route;

6 means for receiving in said first edge router said plurality of layer-3 datagrams;

7 means for determining in said first edge router a subset of layer-3 datagrams, with  
8 each datagram in said subset of layer-3 datagrams having a corresponding layer-3 route  
9 equal to said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said  
10 plurality of layer-3 datagrams;

11 means for encapsulating each of said subset of layer-3 datagrams in a corresponding  
12 plurality of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of  
13 said subset of layer-3 datagrams being encapsulated for sending on a first one of said  
14 plurality of virtual circuits and all of the plurality of layer-2 packets corresponding to some  
15 other of said subset of layer-3 datagrams being encapsulated for transmission on another one  
16 of said plurality of virtual circuits; and

17 means for sending said plurality of layer-2 packets related to said subset of layer-3  
18 datagrams on said layer-2 network according to said encapsulating.

1 19 (Currently Amended): The first edge router of claim 18, wherein said means for  
2 determining uses a destination address comprised in each of said layer-3 datagrams to  
3 determine said corresponding layer-3 route.

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4 wherein said means for determining further determines whether to transmit each of  
5 said subset of layer-3 datagrams in either said first one of said plurality of virtual circuits or  
6 said another one of said plurality of virtual circuits, and  
7 wherein said means for encapsulating uses a header which identifies the determined  
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

1 20 (Original): The first edge router of claim 19, further comprising means for  
2 selecting one of said plurality of virtual circuits for transmitting each of said subset of layer-  
3 3 datagrams.

1 21 (Original): The first edge router of claim 20, wherein said means for determining  
2 retrieves a route entry from a forwarding table using said destination address of a first IP  
3 datagram, wherein said route entry indicates whether said IP route is to be used to transport  
4 said first IP datagram, and wherein said selecting is performed based on said route entry.

1 22 (Original): The first edge router of claim 20, wherein said means for determining  
2 and said means for selecting are implemented using a data structure, which when traversed  
3 using said destination address returns a layer-2 header corresponding to a virtual circuit on  
4 which a corresponding IP datagram is to be sent.

1 23 (Original): A first edge router for processing a plurality of layer-3 datagrams, said  
2 first edge router being connected to a second edge router by a layer-2 network, said first edge  
3 router comprising:

4 a memory storing data indicating that a plurality of virtual circuits are provisioned  
5 to said second edge router on said layer-2 network, said data further indicating that said  
6 plurality of virtual circuits are associated with a layer-3 route;

7 an inbound interface receiving said plurality of layer-3 datagrams, wherein a subset  
8 of layer-3 datagrams comprised in said plurality of layer-3 datagrams are to be transmitted  
9 on said layer-3 route;

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10 a virtual circuit (VC) determination block determining to send some of said subset  
11 of layer-3 datagrams on a first one of said plurality of virtual circuits and some other of said  
12 subset of layer-3 datagrams on another one of said plurality of virtual circuits; and  
13 an outbound interface sending each of said subset of layer-3 datagrams on a  
14 determined one of said plurality of virtual circuits in the form of a plurality of layer-2  
15 packets on said layer-2 network.

1 24 (Currently Amended): The first edge router of claim 23, further comprising:  
2 a forwarding block determining that said subset of layer-3 datagrams are to be  
3 transmitted on said layer-3 route based on a destination address contained in each of said  
4 plurality of layer-3 datagrams, wherein said VC determination block determines the specific  
5 virtual circuit on which to forward each of said subset of layer-3 datagrams after said  
6 forwarding block determines that said subset of layer-3 datagrams are to be transmitted on  
7 said layer-3 router,  
8 a segmentation block segmenting each of said subset of layer-3 datagrams into a  
9 plurality of payloads; and  
10 an encapsulator encapsulating said plurality of payloads in a corresponding plurality  
11 of layer-2 packets, wherein said plurality of layer-2 packets corresponding to each layer-3  
12 datagram are encapsulated according to the determination of said VC determination block;  
13 ~~wherein said determining comprises using a destination address comprised in each of said~~  
14 ~~layer-3 datagrams to determine said corresponding layer-3 route.~~

1 25 (Original): The first edge router of claim 24, wherein said layer-2 network  
2 comprises a plurality of switches providing a plurality of physical paths between said first  
3 edge router and said second edge router, said first one of said plurality of virtual circuits  
4 being provided on a first one of said plurality of physical paths and said second one of said  
5 plurality of virtual circuits being provided on a second one of said plurality of physical  
6 paths.

1 26 (Currently Amended): The first edge router of claim 24, further comprising:

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2 a forwarding table containing a plurality of route entries, ~~and~~  
3 a wherein said forwarding block retrieving a route entry from said forwarding table  
4 using said destination address of a first IP datagram, wherein said route entry indicates  
5 whether said IP route is to be used to transport said first IP datagram, and wherein said VC  
6 determination block selects either said first one of said plurality of virtual circuits or said  
7 another one of said plurality of virtual circuits based on said route entry.

1 27 (Original): The first edge router of claim 24, further comprising a data structure,  
2 which when traversed using said destination address returns a layer-2 header corresponding  
3 to a virtual circuit on which a corresponding IP datagram is to be sent.

1 28 (Original): The first edge router of claim 2, wherein layer-3 comprises Internet  
2 Protocol (IP) such that layer-3 datagrams, layer-3 protocol, and layer-3 route respectively  
3 comprise IP datagrams, IP protocol, and IP route.

1 29 (Original): The first edge router of claim 28, wherein each of said plurality of  
2 virtual circuits comprises a permanent virtual circuit (PVC).

1 30 (Original): The first edge router of claim 29, wherein datagrams related to the  
2 same flow are transmitted on the same virtual circuit such that an end system need not re-  
3 sequence the data in the received datagrams.